Please cancel existing claims 1-4, 8-27, 29-71, 73 and 84. Please amend the non-cancelled claims as follows (a complete set of the non-cancelled claims is included for the convenience of the Examiner even if no amendment has been made).

5. A central unit modem apparatus comprising:

a framing circuit having a memory and circuitry to receive downstream data and store it in said memory organized as frames of data each frame comprising one or more symbols, and having circuitry to read data out of said memory and present said downstream data at an output;

a transmitter coupled to receive said downstream data from said output and having circuitry to multiplex said downstream data onto a transmission media using any form of multiplexing and any form of modulation; and

a synchronous code division multiplexed receiver coupled to receive modulated upstream signals from a plurality of remote unit modems and having circuitry to demodulate and demultiplex said upstream signals and detect upstream data from said demodulated, demultiplexed upstream signals.

6. The apparatus of claim 5 wherein said transmitter includes circuitry to transmit downstream information defining the phase and frequency of a master clock signal and a master carrier signal, and wherein said upstream signals include signals therein which define the phase and frequency of clock and carrier signals used in said remote unit modems to generate said upstream signals, and wherein said synchronous code division multiplexed receiver includes tracking loop circuitry to track the phase and frequency of the clock and carrier signals used by each remote unit modem and

generate clock and carrier signals locked in phase and frequency to the clock and carrier signals used in said remote unit modem to generate said upstream signals, and circuitry to use said generated clock and carrier signals to demodulate and demultiplex said upstream signals and detect said upstream data from said demodulated, demultiplexed upstream signals.

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7. (AMENDED) The apparatus of claim 5 wherein said transmitter includes circuitry to transmit downstream information defining the phase and frequency of a master clock signal and a master carrier signal, and wherein said upstream signals include signals therein which define the phase and frequency of the clock and carrier signals used by said remote unit modems to generate said upstream signals wherein said clock and carrier signals used in said remote unit modems to generate said upstream signals are locked in phase and frequency with or are at least phase coherent with, master clock and master carrier signals recovered from said downstream information transmitted by central unit transmitter and wherein said upstream signals include preamble data transmitted by each remote unit modem prior to transmission by that remote unit modem of any upstream payload data, and wherein said synchronous code division multiplexed receiver include circuitry to use said preamble data from each remote unit modem to determine [the phase differences] <u>phase and amplitude correction factors</u> for <u>use in said synchronous code division multiplexed receiver along with said master clock and master carrier signals to receive data transmitted by</u> that particular remote unit modem [between the master clock and master carrier signals at said central unit modem and the clock and carrier signals used by that particular remote unit modem as received at said central unit modem], and for storing said [phase differences]

amplitude and phase correction factors for each remote unit modem in memory [for use with said central unit modem master clock and master carrier signals in] and wherein said synchronous code division multiplexed receiver includes circuitry for demodulating[,] and demultiplexing said upstream signals and detecting upstream data therein[, said circuitry for occasionally updating said phase differences for each particular remote unit modem when said particular remote unit modem again transmits preamble data].

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28. (AMENDED) A bidirectional digital data communication system including a central unit transceiver having circuitry for accepting downstream data from multiple sources organized into a time division multiplexed stream of data and assembling symbol data therefrom, and including multiplexer and modulator circuits for code division multiplexing said downstream symbol data and modulating the resulting multiplexed data onto one or more [RF] radio frequency carriers and transmitting the resulting downstream [RF] radio frequency signals on a shared media and including a plurality of remote unit transceivers including demodulating and demultiplexing and detecting circuitry to demodulate said downstream signals and demultiplex the resulting demodulated signals and detect the symbols that were transmitted and output the downstream data that was to assemble each symbol, and including deframer circuitry for receiving the resulting [demultiplexed] detected downstream data and reassembling a time division multiplexed stream of downstream data therefrom, said remote unit transceivers including circuitry to receive upstream data from multiple sources in time division multiplexed streams and assemble upstream symbols therefrom, and including multiplexing and modulator circuitry to code division multiplex said upstream symbol

data and modulate the resulting multiplexed data onto one or more [RF] radio frequency carriers and transmit the resulting upstream [RF] radio frequency signals on said shared media using frequency division multiple access to separate the upstream [RF] radio frequency signals from the downstream [RF] radio frequency signals, said central unit transceiver including demodulator and demultiplexing circuitry to demodulate and demultiplex the upstream [RF] radio frequency siganls and detector circuitry to detect the upstream symbols that were transmitted by each remote unit transceiver and output the upstream data that was used to compose each upstream symbol, and including deframer circuitry to receive the [demultiplexed] detected upstream data and reassemble a time division multiplexed data stream therefrom.

72. A head end modem for providing multiple-user, multiple-source simultaneous digital communication over a limited bandwidth with one or more remote unit modems in a distributed systems linked by a transmission medium, comprising:

a framing/addressing/packetizing circuit for receiving payload data bytes and organizing said payload data into frames and organizing said payload data such that information as to which remote unit modem and peripheral each payload data byte is directed can be determined;

a master clock for generating a master clock signal;

a master carrier local oscillator for generating one or more carrier signals which will be modulated with digital data to be transmitted;

a transmitter for receiving said data from said framing/addressing/packetizing circuit and said master clock signal and said one or more carrier signals and using said data to modulate said one or more carrier signals using any modulation process which can also transmit said master clock

reference signal and said carrier signals to said remote unit modems for use there for synchronization including synchronization to said frame boundaries, said transmitter coupled to said transmission media so as to output said one or more modulated carrier signals as downstream radio frequency signals; and

an [SCDMA] synchronous code division multiplexed receiver coupled to receive upstream [RF] radio frequency signals modulated with [digital] upstream data transmitted by said remote unit modems, said receiver [and] coupled to said master clock and said master carrier local oscillator to receive said master clock signal and said master clock local oscillator, said [SCDMA] synchronous code division multiplexed receiver functioning to synchronously extract said upstream [payload] data from said upstream [RF] radio frequency signals by performing the inverse code transformation of a code transformation which was performed by an [SCDMA] synchronous code division multiplexed transmitter in a remote unit modem which modulated said upstream [RF] radio frequency signals by spreading the spectrum thereof using orthogonal, pseudorandom spreading codes assigned to that remote unit modem[, said inverse code transformation performed on signals received from a particular remote unit modem using the same orthogonal spreading codes used by said remote unit modem], said extracted upstream [payload] data being presented at an output;

a gap monitor circuit coupled to said [SCDMA] synchronous code division multiplexed receiver for aiding the process of achieving frame synchronization by said remote unit [modesm] modems by monitoring an interval during each frame for the presence of [unique codes] ranging signals transmitted by said remote unit modems and for generating status data indicating how many [codes]

ranging signals have been received during said interval and, after only ranging signals from one remote unit modem are being received during said interval, which intervals have received ranging signals so as to identify the remote unit modem which transmitted said ranging signals;

a circuit for receiving said status data from said gap monitor circuit and generating suitable management and control data needed by the remote [units] unit modems to achieve frame synchronization such that all frames of like number transmitted by the various remote unit modems arrive at said central unit modem at the same time[; and

a data transfer circuit for receiving said management and control data and causing said transmitter to transmit same during an interval dedicated to transmission of said management and control data.]

74. A transmitter apparatus for simultaneously transmitting to a receiver multiple channels of digital data over a cable television media carrying cable television programming, comprising:

a framer circuit for receiving a time division multiplexed stream of data comprised of N timeslots per frame, each timeslot carrying digital data from one of N channels, said framer for storing in a memory the data from selected ones of said timeslots assigned to said transmitter, and for generating an information vector having N elements corresponding to said N timeslots, predetermined ones of said information vector elements corresponding to said selected timeslots assigned to said transmitter from which data was stored by said framer circuit, each of said predetermined elements of said information vector corresponding to timeslots assigned to said transmitter comprised of a plurality of bits which

constitute a fraction of the data of one of said timeslots assigned to said transmitter;

a convolutional encoder for selectively adding one or more redundant bits to each element of said information vector to implement trellis modulation to generate a new information vector;

a code division multiplexer circuit for matrix multiplying said new information vector times a code matrix comprised of N mathematically orthogonal codes, each row comprised of an orthogonal code having N elements to generate a result vector having N elements;

a modulator for using each element of said result vector to quadrature amplitude modulate two radio frequency carriers having the same frequency but separated in phase by 90 degrees to generate inphase and quadrature RF signals, said modulation being achieved by dividing the bits of each element of said result vector into first and second parts and using the number represented by each part to define the amplitude of said inphase and quadrature RF signals, respectively, and summing said inphase and quadrature RF signals prior to transmission on said cable television media;

means for achieving frame synchronization between frames transmitted by said transmitter apparatus and the frame boundaries of frames within said receiver.

75. The apparatus of claim 74 further comprising a scrambler circuit coupled to receive elements of said information vector from said framer circuit, pseudorandomly scramble the bits of each element thereof to generate a scrambled

information vector, and transmit said scrambled information vector to said convolutional encoder and wherein said convolutional encoder encodes the elements of said scrambled information vector with redundant bits.

76. The apparatus of claim 75 wherein said convolutional encoder has an idle mode wherein only zeroes are added as redundant bits, a normal mode wherein a first selected number of redundant bits are added to each element of the information vector based upon the data selected from the same timeslot of an earlier time to generate the same element of a previous information vector, and a fallback mode wherein a number of redundant bits larger than said first selected number of redundant bits are added to each element of said information vector to generate said new information vector, the mode in which said convolutional encoder operates being selectable by manipulation of a mode control signal transmitted to a mode control input of said convolutional encoder.

77. The apparatus of claim 76 further comprising code diversity means coupled to said framer circuit for controlling the order in which said information vector elements are read from said framer circuit and input to said scrambler circuit, and further comprising a buffer memory for storing said scrambled information vector, said code diversity means controlling the locations in said buffer memory in which is stored each scrambled element of said scrambled information vector.

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78. (AMENDED) The apparatus of claim 75 further comprising a precode filter coupled to receive at least said elements of said result vector and <u>including means for performing</u> [to perform] an equalization process thereon to predistort said result vector

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elements prior to transmission to generate predistorted result vector elements and wherein said modulator uses said predistorted result vector elements to generate said inphase and quadrature RF signals such that said inphase and quadrature RF signals arrive at said receiver with substantially less distortion caused by impairments encountered in propagating along said cable television medium, said precode filter having an input for receiving a coefficient signal which controls the characteristics of the predistortion function applied to to the elements of said result vector.

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79. The apparatus of claim 78 wherein said coefficient signal is set so as to establish said characteristics of said predistortion function based upon the position of the transmitter on said cable television media and the impairments then existing which will affect signals transmitted from a transmitter at that position.

80. The apparatus of claim 75 further comprising a shaping filter coupled to receive said scaled result vector elements before they are supplied to said analog to digital converter, said shaping filter having a raised cosine transfer function suitable to limit the bandwidth of the combined RF signal generated by summing said inphase and quadrature RF signals and suitable to satisfy the Nyquist criteria so as to optimize signal-to-noise ratio and minimize interference with signals from other transmitters coupled to said cable television media.

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81. (AMENDED) The apparatus of claim 75 wherein each timeslot contains 8 bits of data to which a 9th bit is added, said 9th bit encoded with predetermined nonpayload information, and wherein said framer circuit stores all 9 bits [from

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timeslots assigned to it] in memory locations in memory, and wherein data is read out from said framer circuit in frames, each frame comprised of three symbols, each symbol having N elements corresponding to the N elements of an information vector, and wherein, during each frame, said framer circuit outputs three sequential information vectors from which the three sequential symbols of the frame will be generated, the elements of each of said three sequential information vectors each corresponding to a timeslot currently assigned to said transmitter, each said element containing three of the nine bits from the corresponding assigned timeslot, said three bits hereafter called a tribit, and wherein said convolutional encoder, when operating in normal mode, adds a 4th redundant bit to each tribit to generate the elements of said new information vector prior to said matrix multiplication carried out by said code division multiplexer circuit on said new information vector.

82. The apparatus of claim 75 wherein said code division multiplexer circuit generates each of said N mathematically orthogonal codes from a cyclic code and is structured to perform said matrix multiplication by generating one orthogonal code, multiply each code element of the code so generated by a corresponding element of said new information vector, and sum the partial products to generate an element of said result vector and then generate the next orthogonal code from the cyclic code and repeat the process to generate the next element of said result vector.

PLEASE ADD THE FOLLOWING NEW CLAIMS

84 ~~85~~. A head end apparatus comprising:

a master clock for generating a master clock signal;

a master carrier local oscillator for generating a master carrier signal;

a demodulator coupled to receive at least master clock signals, for demodulating received radio frequency carriers modulated with upstream data by one or more remote unit modems and ouput one or more result vectors of multiplexed upstream data, each result vector comprised of a plurality of chips;

a demultiplexer coupled to receive said result vectors and said master clock and functioning to demultiplex the data in said result vectors so as to output one or more information vectors, each comprised of a plurality of received constellation points, each of which may or may not be corrupted by channel impairments; and

adjustment means for receiving said information vectors transmitted by each said remote unit modem and using preamble data therein to correct for phase and amplitude errors in data transmitted by each said remote unit modem and outputting corrected information vectors, each comprised of corrected constellation points;

a detector comprised of at least a slicer coupled to receive said master clock and said corrected constellation points of said corrected information vectors and functioning to detect and output the actual upstream data corresponding to each said corrected constellation point that was transmitted by each said remote unit modem.

86. The apparatus of claim 85 wherein said demodulator, demultiplexer, adjustment means and detector are all part of a synchronous time division multiplexed data receiver, and wherein said demodulator uses both said master carrier and said master clock signals to demodulate said radio frequency signals modulated with upstream

data.

~~87.~~ The apparatus of claim ~~65~~ wherein said demodulator, demultiplexer, adjustment means and detector are all part of a synchronous code division multiplexed data receiver and wherein said demodulator uses both said master carrier and said master clock signals to demodulate said radio frequency signals modulated with upstream data.

~~88.~~ The apparatus of claim ~~85~~ further comprising a downstream transmitter of any type to transmit downstream data to said remote unit modems, and wherein said demodulator, demultiplexer, adjustment means and said detector are all part of an upstream receiver.

~~89.~~ The apparatus of claim ~~88~~ wherein said demodulator, demultiplexer, adjustment means and detector are all part of a synchronous code division multiplexed data receiver, and wherein said downstream transmitter is structured to transmit spreading code assignment data which said remote unit modems use to determine which spreading codes to use during specific upstream frames and further is structured to transmit a pilot channel signal which encodes a kiloframe marker which said remote unit modems use to count upstream frames so that the assigned spreading codes will be used to multiplex upstream data during the assigned upstream frames.

~~90.~~ The apparatus of claim ~~88~~ wherein said downstream transmitter is structured to transmit a pilot channel signal which encodes a kiloframe marker which

said remote unit modems use to count upstream frames, and further comprising boundless ranging means for transmitting downstream frames to said remote unit modems and counting downstream frames and for responding to upstream boundless ranging requests from said remote unit modems by determining a total turnaround time for the remote unit modem that transmitted said boundless ranging request by determining the difference in frame numbers between an upstream frame number included in said boundless ranging request and the current downstream frame count at the time of receipt of said upstream boundless ranging request and transmitting said total turnaround time to said remote unit modem that transmitted said upstream boundless ranging request.

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~~91~~. The apparatus of claim ~~85~~ further comprising any downstream transmitter for transmitting downstream data in frames and transmitting a barker code between or during each said frame which encodes said master clock so that said master clock may be recovered by each said remote unit modem and used for transmitting said upstream data.

91 87
~~92~~. The apparatus of claim ~~88~~ wherein said downstream transmitter transmits downstream data in frames separated by gaps, and is structured to transmit a downstream ranging signal, and wherein said upstream receiver includes ranging means for monitoring upstream transmissions during said gaps for receipt of upstream ranging signals and for transmitting downstream data which can be used by said remote unit modems to adjust their transmit frame timing delays so that all upstream frames transmitted by all said remote unit modems have their frame boundaries aligned in time.

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~~93~~. The apparatus of claim ~~92~~ further comprising prechannel equalization filter in said downstream transmitter for filtering transmitted signals to compensate for channel impairments in the downstream channel, and post channel equalization circuitry in said upstream receiver for compensating for channel impairments in upstream channels from said remote unit modems.

as

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~~94~~. The apparatus of claim ~~88~~ further comprising ranging means in said downstream transmitter and said upstream receiver for transmitting ranging signals to said remote unit modems and receiving ranging transmissions from said remote unit modems and transmitting data to said remote unit modems that enables each remote unit modem to achieve frame synchronization, and wherein said upstream receiver is a synchronous code division multiplexed receiver, and futher comprising training means in said downstream transmitter and said upstream receiver for receiving training data transmitted by a remote unit modem on a particular spreading code after said remote unit modem has achieved frame synchronization, and for checking the accuracy of said frame synchronization and for transmitting adjustment data to said remote unit modem to be used by said remote unit modem to achieve greater precision in frame synchronization if said training data is not received properly on the spreading code used to transmit said training data.

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~~95~~. The apparatus of claim ~~94~~ wherein said training means includes power alignment means for computing a new power level for use by said remote unit modem which transmitted said training data based upon the degree of success in receiving said training data transmitted on said particular spreading code of said frame

synchronization and transmitting said new power level to said remote unit modem.

95 87
~~96.~~ The apparatus of claim ~~88~~ further comprising power alignment means for receiving training data transmitted by each remote unit modem and adaptively adjusting to a gain correction factor which minimizes receive errors and transmitting the gain level which caused minimum errors to said remote unit modem which transmitted said training data.

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~~97.~~ The apparatus of claim ~~88~~ further comprising upstream equalization means in said downstream transmitter and said upstream receiver for deriving filter coefficients that equalize channel impairments in an upstream channel between a remote unit modem and said head end apparatus during the process of receiving iterative transmissions of training data transmitted by a remote unit modem, and then transmitting said filter coefficients to said remote unit modem which transmitted said training data for use in generating new coefficients for use by said remote unit modem in subsequent upstream transmissions.

97
~~98.~~ A process for receiving upstream data in a central unit modem transmitted by a plurality of remote unit modems in a digital data communication system comprised of a plurality of remote unit modems coupled to said central unit modem by a shared transmission medium, comprising the steps of:

generating a master clock signal in said central unit modem;

generating a master carrier signal in said central unit modem;

transmitting data to said remote unit modems from which said master

clock and master carrier signals can be recovered in each remote unit modem;

using at least said master clock signal in said central unit modem to demodulate upstream radio frequency transmissions from said remote unit modems that contain upstream data to generate one or more result vectors of multiplexed upstream data, each result vector having a plurality of chips as elements thereof;

demultiplexing said result vectors using said master clock so as to generate one or more information vectors, each comprised of a plurality of received constellation points each of which may or may not be corrupted by channel impairments;

using known preamble data transmitted by each remote unit modem as part of upstream data transmitted by that remote unit modem to derive amplitude and phase error correction factors for use in receiving upstream data transmitted by that remote unit modem and using said amplitude and phase error correction factors to correct each said received constellation point to generate a corrected constellation point;

detecting the actual upstream data that corresponds to each said corrected constellation point synchronously with said master clock.

98 97

~~99~~. The process of claim ~~98~~ wherein said demodulating step is accomplished by generating from said master clock signal a carrier signal matched in frequency to the upstream carrier signal used by each remote unit modem to transmit upstream data.

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as 1 ~~100~~. The process of claim ~~98~~ wherein said demultiplexing step comprises
2 demultiplexing time division multiplexed upstream data.

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1 ~~101~~. The process of claim ~~99~~ wherein said demultiplexing step comprises
2 despreading the spectrum of spread spectrum multiplexed upstream.

101 97
1 ~~102~~. The process of claim ~~98~~ further comprising the steps of transmitting a
2 ranging signal downstream for use by said remote unit modems in achieving frame
3 synchronization, and receiving upstream ranging transmissions from said remote unit
4 modems and transmitting data downstream which can be used by each remote unit modem
5 to achieve frame synchronization such that each upstream frame transmitted by said
6 remote unit modem arrives at said central unit modem with its frame boundaries aligned
7 in time with the frame boundaries of other upstream frames transmitted by other
8 remote unit modems.

102 101
1 ~~103~~. The process of claim ~~102~~ further comprising the steps of:
2 counting downstream frames in said central unit modem;
3 transmitting data downstream which encodes a kiloframe marker signal
4 which said remote unit modems can use to count upstream frames;
5 receiving an upstream boundless ranging request from a remote unit
6 modem containing the current downstream frame count at said remote unit
7 modem as counted by said remote unit modem using said kiloframe marker signal
8 and responding by calculating a total turnaround time as the difference between
9 the current downstream frame count in said central unit modem at the time said

boundless ranging request was received and said frame count included in said boundless ranging request;

transmitting said total turnaround time to said remote unit modem which transmitted said boundless ranging request;

and further comprising the steps of:

receiving upstream bandwidth requests from one or more remote unit modems and performing an allocation of upstream logical channels using any allocation scheme;

transmitting messages to said remote unit modems awarding logical channels to said remote unit modems for specifically designated upstream frames in accordance with the results of said allocation.

103 ~~104~~. The process of claim 101 ~~102~~ further comprising the steps of from time to time performing a training process to check the accuracy of said frame synchronization and cause any remote unit modems which are not exactly in frame synchronization to be adjusted, and adjusting the power level of transmissions by each said remote unit modem such that transmissions from each said remote unit modem arrive at said central unit modem at a power level that minimizes reception errors by receiving training data transmitted by a remote unit modem and allowing an adaptive gain control circuit in said central unit modem to change its gain adaptively to minimize reception errors and then transmitting the gain level settled upon to the remote unit modem and setting the gain of said adaptive gain control circuit to one during reception of transmission from the remote unit modem whose gain has been so adjusted, and for developing filter coefficients for upstream precode equalization filters in each said remote unit modem in

said central unit modem and transmitting said coefficients developed for each said remote unit modem to said remote unit modem for use in adjusting coefficients of an upstream precode equalization filter therein, and for transmitting training data to a remote unit modem having the spectrum spread by each of a plurality of adjacent cyclic spreading codes to allow said remote unit modem to adapt the coefficients of the downstream equalization filters therein to adjust for downstream channel impairments.

104
~~105~~. A process for bidirectional synchronous time division multiplexed communication of digital data to a central unit modem connected from a plurality of remote unit modems over a shared transmission medium, comprising the steps of:

generating a master clock signal in said central unit modem;

generating a master carrier signal in said central unit modem;

transmitting data to said remote unit modems from which at least said master clock can be recovered in each remote unit modem, and transmitting downstream data in frames using any modulation and multiplexing scheme including no multiplexing such that each frame is broadcast to all remote unit modems;

using said master clock signal and said master carrier signal in said central unit modem and using known preamble data transmitted by each remote unit modem as part of upstream data transmitted by that remote unit modem to derive amplitude and phase error correction factors for use in receiving upstream data transmitted by that remote unit modem;

using said master clock signal and said master carrier signal in said central unit modem to demodulate and demultiplex upstream data transmitted as a

plurality of time division multiplexed constellation points by each remote unit modem and using said amplitude and phase error correction factors developed for each remote unit modem to recover the upstream data encoded in each received constellation point.

105

~~106~~. A transceiver circuit in a central unit modem apparatus for providing multiple user simultaneous access for supplemental digital data services via a shared transmission medium coupled between said central unit modem and a one or more physically distributed remote unit modems, comprising:

a transmitter comprising:

a master clock;

means for generating a master carrier;

any transmitter means for receiving downstream data intended for said remote unit modems and transmitting said downstream data to said remote unit modems using said master clock and said master carrier, said transmitter means including means for transmitting data encoding said master clock and said master carrier to all said remote unit modems on one or more radio frequency carriers in a first frequency band;

a synchronous code division or synchronous time division multiplexed receiver means for using at least said master clock and master carrier and preamble data transmitted by each said remote unit modem prior to transmission of upstream payload data to demodulate, demultiplex and recover upstream payload data transmitted by multiple remote unit modems where each sai remote unit modem uses a recovered